IHP Motors Overview

IHP Motors Overview

- Market / Applications
- Emerson Overview
- Competition
- Nameplate Electrical Data
- Mounting Considerations
- Inverter Duty Motors
- NEMA Premium

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IHP HVAC Market – Air Conditioning

- Application: Circulates Air for Conditioning
  - Heating and Cooling in Commercial Buildings
  - Packaged Units and Air Handlers
- Major OEMs:
  - Carrier, Lennox, McQuay, Trane, York
  - Chicago Blower, Greenheck, Penn Vent
- Product: ODP

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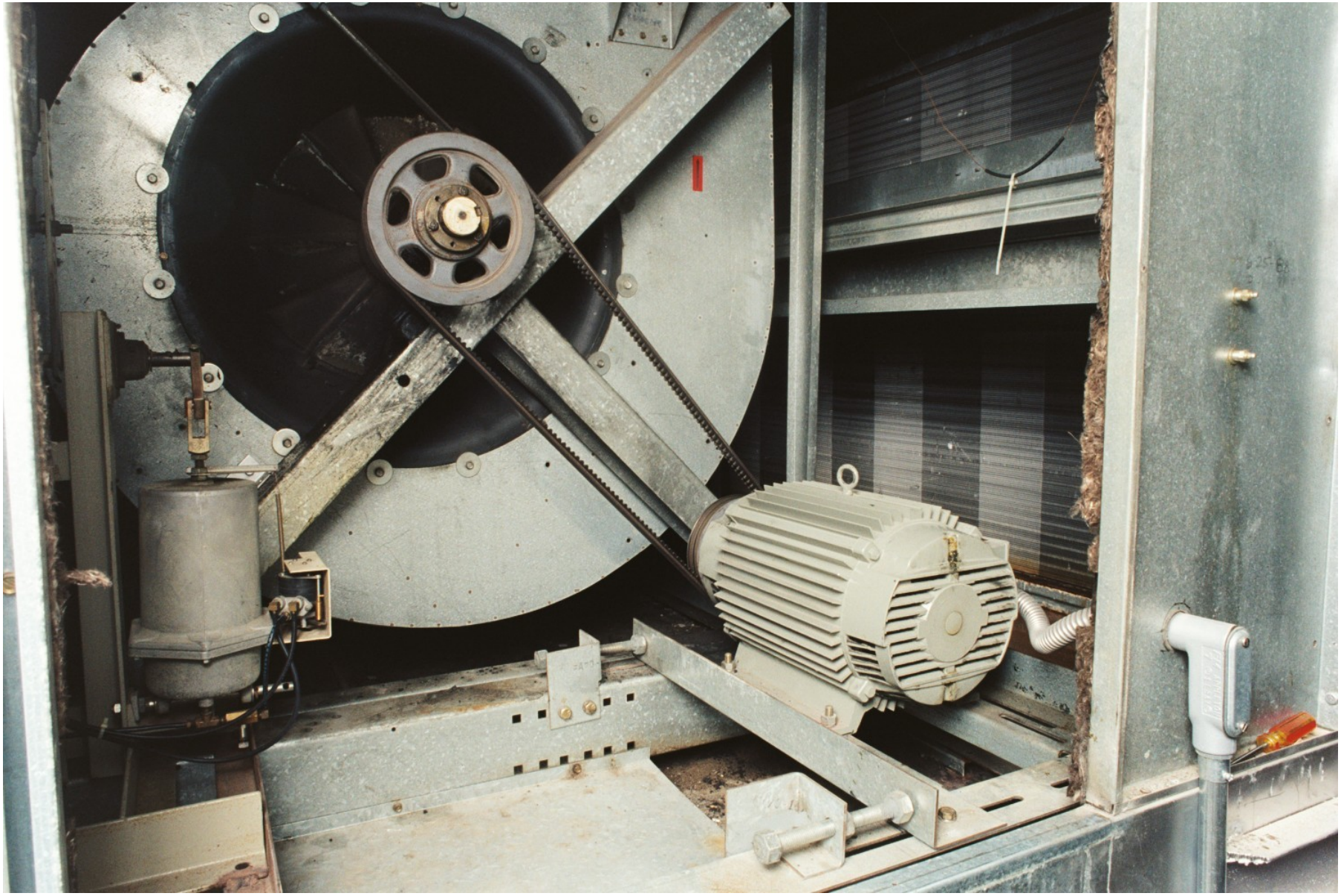

IHP HVAC Market – Cooling Towers

- Application: Evaporative Cooling
  - Remove Heat on Closed Loop Systems
  - Dehumidification Systems
- Major OEMs:
  - Baltimore Air Coil, Evapco & Marley
- Product: TEAO or TEFC
- Opportunity: Sell up to a 2 speed motor
  - On low, the unit can run at 60% on only 15% power consumption
  - Another good reason to buy a new motor & 2 stage T’stat
  - Typically less than a 2 year pay back!

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DANGER
evapco

IHP HVAC Market – Industrial Blowers

- Application: Supply or Make Up Air
  - Typically Mfg. Process Oriented
  - Drying or Cooling Applications
  - High Volume Ventilation (i.e. painting)
- Major OEMs:
  - Howden Buffalo, Greenheck, NY & Chicago Blower
- Product: ODP or TEFC

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IHP HVAC Market – Pumping

- Application: Moving Glycol for Chiller Systems
  - Heating and Cooling in Commercial Buildings
- Major OEMs:
  - Bell & Gossett, Goulds, Taco
- Product: ODP, C-Face Footed & Footless

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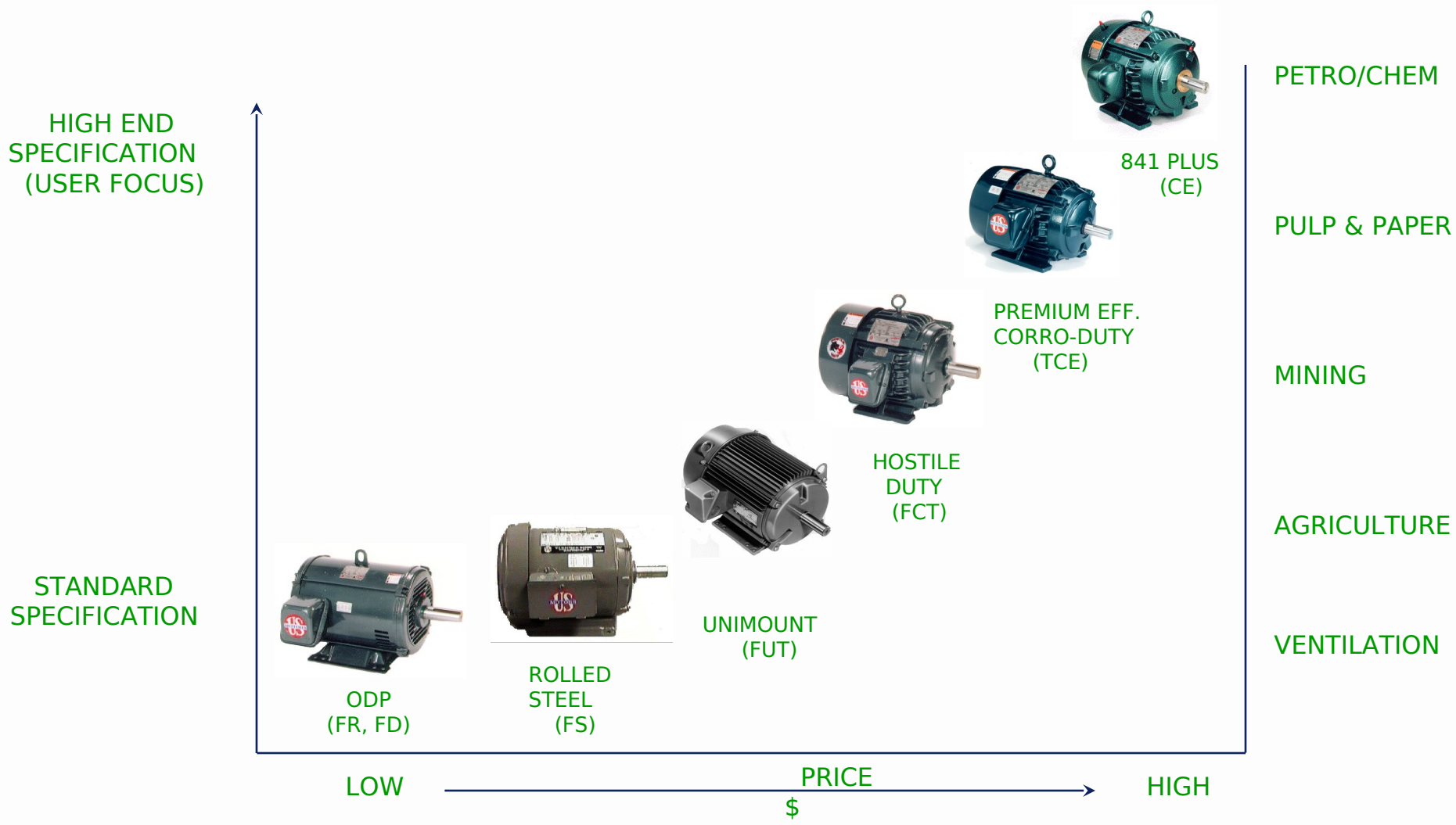
NEMA Product / Market Mix Summary



IHP HVAC Market - Customers

- **Primary Customers for our wholesalers**
  - **Contractors – HVAC & Mechanical**
  - **End Users – Maintenance Dept. / Service Companies**
- **Types of Sale**
  - **Replacement of failed unit**
  - **Upgrade**
    - **Emphasis on Premium Efficiency and correct motor sizing**
    - **Opportunity to sell features**
    - **New business for our customers!**

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Why Buy Emerson's IHP Motors ?

- The Company
  - Motor experience since 1908 for US Electric
  - Part of largest producer of electric motors in the world.
  - Financially secure, a core business of Emerson
  - Outstanding engineering and technical support
  - Member of NEMA
  - Linked to D.O.E., NRCan other government and trade efficiency programs
  - National sales and service coverage.

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Available Product Scope

- 1 THROUGH 400 HORSEPOWER
- 2, 4, 6, AND 8 POLE SPEEDS
- 200, 208-230/460 OR 575 VOLT 60 Hz DESIGNS
- 380 VOLT, 50 Hz DESIGNS
- TOTALLY ENCLOSED
  - HOSTILE DUTY CAST IRON 180T THROUGH 447T FRAMES
  - UNIMOUNT ALUMINUM 140T THROUGH 280T FRAMES
- OPEN DRIPPROOF
  - ROLLED STEEL 140T THROUGH 320T FRAMES
  - CAST IRON 360T THROUGH 449T FRAMES

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World Class Features

- Wye-Delta Start on 250 Frame & Larger
- Part-Wind Start on low voltage connection
- Corro-Duty Type Paint, 250 Hour Salt Spray Tested
- New Conversion Features
- 50 or 60 Cycle Operation
  - 208-230/460 or 230/460 at 60Hz operate on 190/380 volt, 50Hz
  - Service factor on 50Hz is 1.0
- Complete 50 or 60Hz Operation Nameplate Data
  - Eliminates much of the need for renameplating, “off the shelf” availability

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Are Emerson Motors in the Market?

- 1/6 -1 HP 190 million units
- 1 - 5 HP 5-8 million units
- 5 HP and larger 3.5 million units
- 30%+ of HVAC applications

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IHP Competition

Motor Repair Shops

- Motors are bought based on a comparison cost of repair versus new and used
- For every six motors that fail today:
  - Five are replaced by a used motor or repaired
  - One is replaced by a new unit
- Motors ≤25 HP should be replaced
  - New Cost & Efficiency vs. Rebuilt
- Availability is the great equalizer
- Shelf Stock drives Wholesale sales!

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IHP Competition

- A O Smith / Magnetek / Century
  - Huge loss of IHP product knowledge in Magnetek buy-out.
  - Moved product to Mexican plant
    - Delivery problems.
    - Quality issues
  - Now changing to out sourced Asian product

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IHP Competition

- Baldor
  - Good distribution structure in place.
  - Notorious for stretching the truth on nameplates
  - Has been buying their way in at large HVAC OEM's the past 5 years, is now seeing what effect its having on their bottom line.
  - Falling stock price and profits is causing concern in Fort Smith.
  - Only major domestic manufacturer that doesn't belong to NEMA. What will they be designing to?

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IHP Competition

- General Electric
  - Uncommitted to the motor business (least profitable of all GE divisions)
  - Varying designs from different countries causing quality to be suspect (strategy is to nameplate from the lowest global bidder)
  - More focused on “high spec” severe duty motors than HVAC applications.
  - Constant turnover in management creates constant change in policies.

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IHP Competition

- Marathon / Leeson / Lincoln
  - Struggling to rationalize multiple brands
  - Distribution channels “confused”
  - Part of Regal Beloit, reputation of “penny-wise but pound foolish”
  - Good quality products (Marathon, Leeson) but cost-cutting measures could affect their standard product.
  - Operating as 3 separate units, hurts synergy

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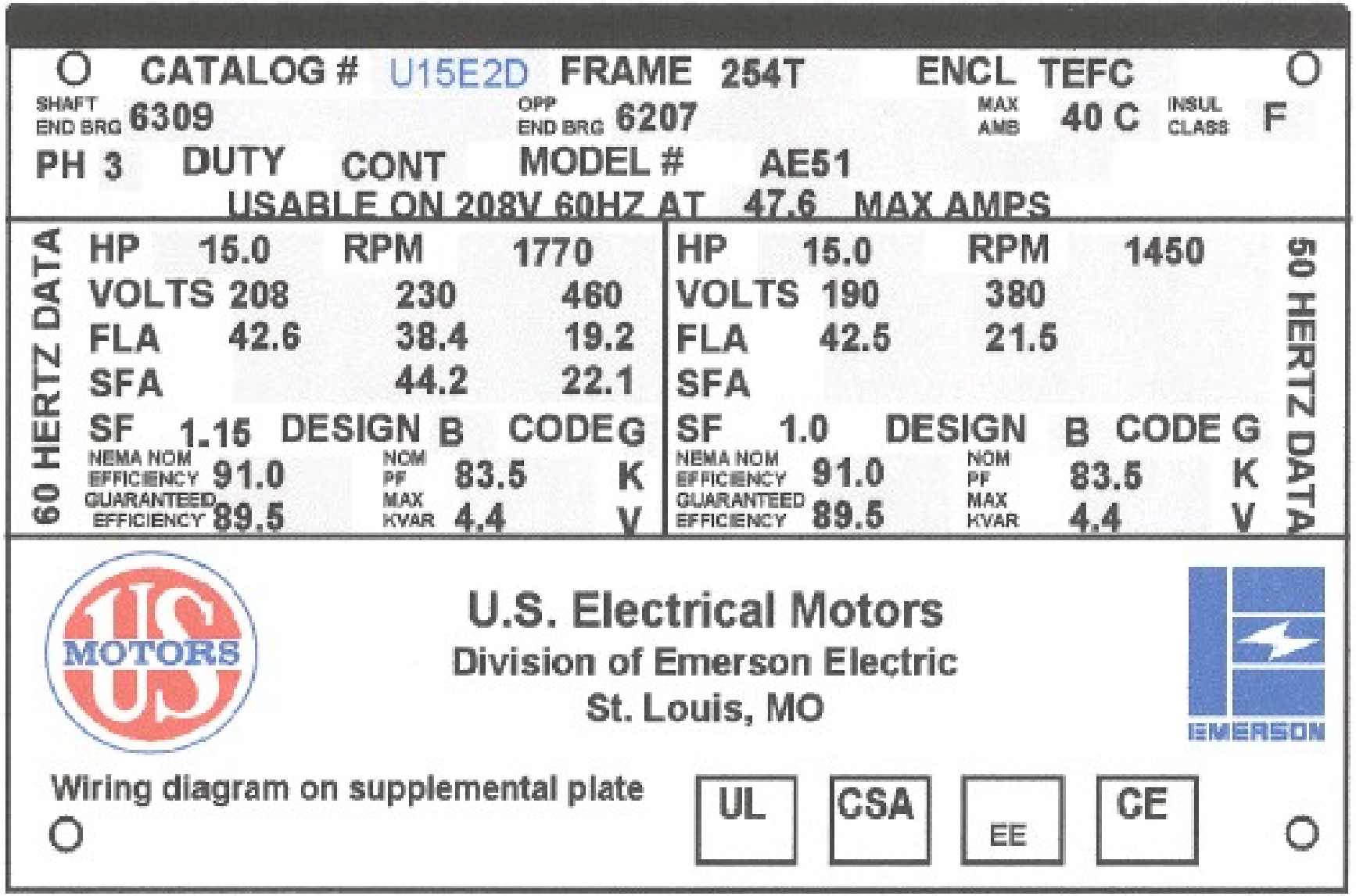
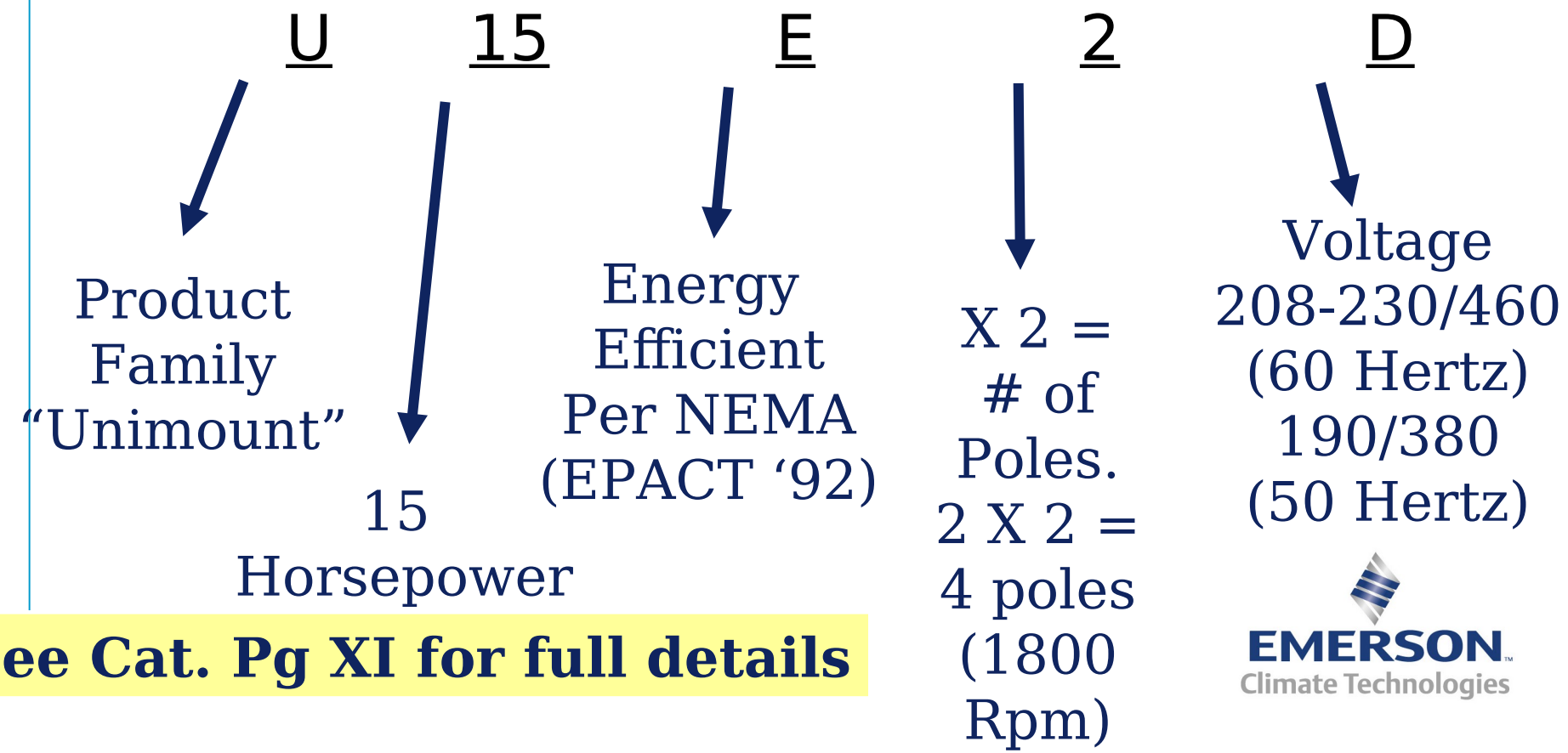
Important Nameplate Information

The Nameplate



Catalog Number

- U S Motor's catalog number can be decoded to give you important information on the motor's characteristics, i.e:



See Cat. Pg XI for full details

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Model or Catalog Number

- One of the most important items on the nameplate of a motor that needs to be replaced.
- We have cross references of many major competitors that cross a competitive motor to a USEM brand.
- These are sorted by either model number or catalog number.

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Frame Size

- NEMA has determined standard dimensions for IHP (three digit) motors and assigns these “frame” dimensions by rating. For example, NEMA says a 15HP 4 pole TEFC motor should be built in a 254T frame. Any motor built in a specific frame (i.e. 254T) will have the same critical mounting dimensions as any other manufacturers motor with the same frame assignment. This makes IHP motors extremely interchangeable.
- See NEMA frame chart for reference.

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Enclosure Types

The motor enclosure must protect the windings, bearings and other mechanical parts from moisture, chemicals, mechanical damage and abrasion from grit. The most popular types of enclosures are:

- Open Drip proof
  - The ODP motor has a free exchange or air with the ambient; drops of liquid or solid particles do not interfere with the operation at any angle from 0 to 15° downward from the vertical. You can use an enclosed motor for replacement in a pinch.
- Totally Enclosed Fan Cooled
  - The TEFC type enclosure prevents free air exchange but still breathes air. A fan is attached to a stub shaft at the opposite load end and pushes air over the frame during operation to help in the cooling process. You cannot use an open motor to replace it.

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Open Drip Proof Enclosure

Open Dripproof
Type FD

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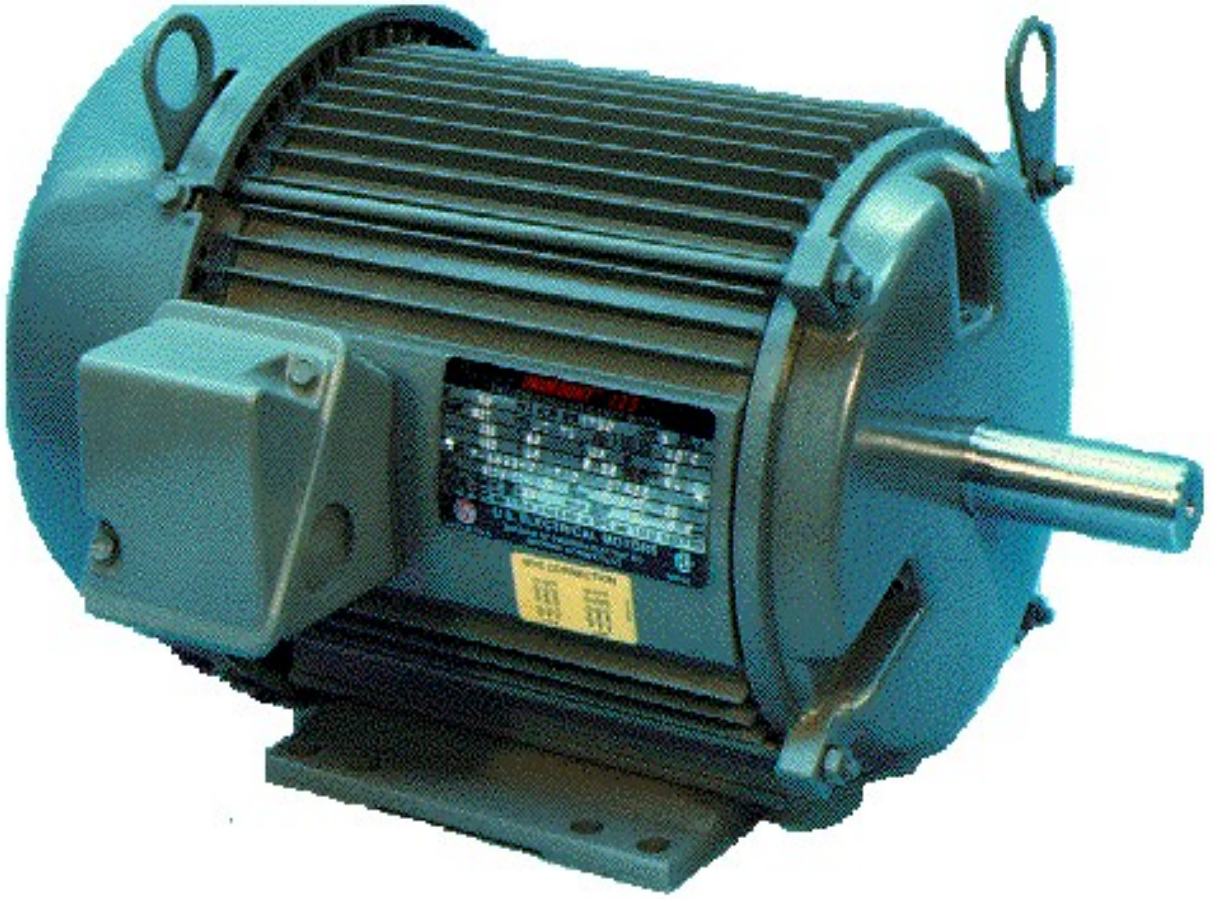
Totally Enclosed Fan Cooled Enclosure



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Max Ambient

- This is the maximum ambient temperature in degrees C that the motor can operate continuously at rated horsepower and service factor without overheating. 40 degree is by far the most common and all standard US Motors are rated 40 degree.
- 40 degree rated motors with a 1.15 or higher service factor can be used in up to 50 degree ambients providing the service factor is not used (rated horsepower max).

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Insulation Class

- NEMA has assigned insulation codes based on the maximum temperature (including ambient) that they can withstand. The most common are:

Class	Temp Rating
A	105C
B	130C
F	155C
H	180C

- Most US motors are class F

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Bearings

- IHP motors will usually have ball bearings up to 200HP. Above 100HP they may have roller bearings if they are in a belted application where there is high radial loading. The bearing size is indicated on the nameplate to ease obtaining replacements.

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Phase

- Will either be noted as single (1) or three (3). By far, most IHP motors are applied on three phase systems. Single phase IHP may be found in rural areas where three phase is not available.

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Duty

- Duty is the time the motor will operate without overheating. Generally this is continuous but could be “60 minute” or some other designation. Continuous rated motors can replace motors rated for shorter periods, but don’t replace a continuous rated motor with a time rated one.

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Horsepower

- This is the continuous load the motor is designed to drive at the ambient rating on the nameplate. NEMA designates IHP nameplate horsepowers as:

1	1.5	2	3	5
7.5	10	15	20	25
30	40	50	60	75
100	125	150	200	250

If you need to replace a motor without one of these ratings, round up.

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RPM

- The speed at which the motor rotates under full load, it is a function of the poles in the motor and the system frequency. No load (theoretical) rpm's for 60Hz motors are:

  2 Pole = 3600rpm 4 Pole = 1800rpm

  6 Pole = 1200rpm 8 Pole = 900 rpm

- Difference between theoretical and full load rpm is slip. The nameplate rpm on IHP motors is usually within 3% of theoretical. Don't worry if it doesn't match exactly, just verify the poles are right.

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Rated Volts

The most frequently occurring domestic voltages are 230 and 460. In Canada 575 volts is common.

Standard induction motors are designed to tolerate voltage variations plus or minus 10%. A motor with a nameplate voltage rating of 230 could be expected to give satisfactory performance when supplied with power ranging from a low value of 207 to a high extreme of 253 volts.

There are many 208V systems in large northeastern cities, older electrical grids and distribution ends. It's best to use a motor designed for these voltages (nameplated 200V), but 230/460V motors can be applied with derated horsepower.

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Rated Volts (continued)

NEMA takes line drop into account when assigning motor nameplate voltages:

System Voltage	Motor Voltage
600	575
480	460
240	230
208	200

If a customer asks for a 240V motor, he really wants 230V for operation on a 240V system.

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Full Load Amps (FLA) & Service Factor Amps (SFA)

- FLA is the amperage the motor should draw at the voltage indicated under rated horsepower. If the motor is drawing more than rated amps it's probably driving more than rated horsepower.
- SFA is the amperage the motor should draw at the voltage indicated at service factor load. If the motor is drawing more than service factor amps it's probably overloaded!
- FLA & SFA are generally not critical in replacing an IHP motor. If you get the rest of the selection criteria right these values should be close.

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Service Factor

- Shows the motor's reserve power. NEMA allows a load "buffer" to be designed into motors.
- The service factor is a multiplier on the rated horsepower that a motor can operate at under unusual conditions without overheating. A 10 hp motor with a 1.25 service factor is able to be loaded up to 12.5 hp without damaging itself.
- You can always replace a motor with one that has a higher service factor. Don't replace a higher service factor motor with one that has a lower service factor!

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Design

- Indicates the starting torque and current inrush of the electrical design as defined by NEMA:

Design	Torque	Inrush Current
A	Medium	High
B	**Medium**	**Low**
C	High	Low
D	Very High	Medium

- By far, most IHP HVAC motors are design B.

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Code

- Indicates the starting KVA per horsepower:

Code	KVA/HP	Code	KVA/HP	Code	KVA/HP
C	3.55-3.99	F	5.00-5.59	J	7.10-7.99
D	4.00-4.49	**G**	**5.60-6.29**	K	8.00-8.99
E	4.50-4.99	H	6.30-7.09	L	9.00-9.99

- Useful when sizing a starter for a motor. Most IHP HVAC motors 10 hp or larger will be code G. Replacing a lower code motor with a higher one may require replacing the motor starter with a higher amp unit. As most of the replacements will be code G, this shouldn't be an issue.

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Nominal and Guaranteed Efficiency

- NEMA has stipulated that test method IEEE112B should be used for determining motor efficiency. There are two values on the nameplate:
  - Nominal - This is the average efficiency that a group of this design will test out at.
  - Guaranteed - This is the minimum efficiency that any of this design will test at.
- Some utilities offer substantial rebates to customers that buy higher efficiency motors. When comparing efficiencies of motors, use the guaranteed values. Some manufacturers play games with their nominal ratings.

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Mounting Considerations

Motor Types & Conversion

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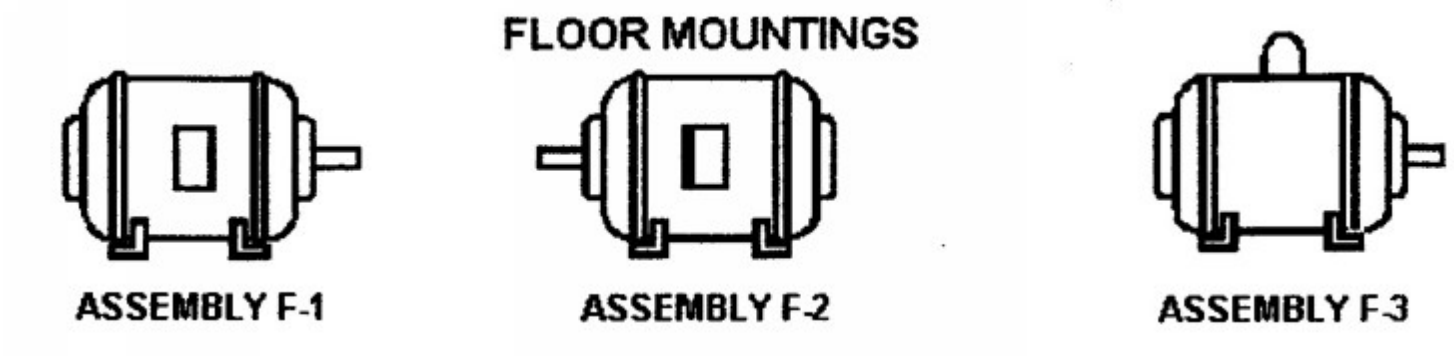
Horizontal Mounting F1 vs. F2

- Standard Floor mounting is F-1 with alternate F-2
- All Cast Iron Motors can be field converted
- All Aluminum also F-2 Field Convertible
- Rolled Steel Motors Default to F-1 only



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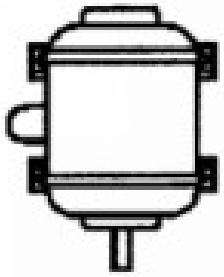
Vertical (Wall/Flange Mounting)

- Vertical Mounting changes ODP
  - Must evaluate use of Drip Cover for ODP
  - TEFC also if liquid drop directly onto fan
- No Mechanical limitation on Vertical Mounting of Horizontal Motors
  - Drain location must be changed
  - Normal thrust only

ASSEMBLY W-5



ASSEMBLY W-6

ASSEMBLY W-7

ASSEMBLY W-8

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Application Mounting Summary

- **Belted Fan – Typically ODP**
  - **Roof Top Units (~1-40hp)**
  - **Fan Coil Units (~1-20hp)**
  - **Inside Air Handlers (~10-150hp)**
- **Direct Drive**
  - **Mostly ODP with some TEFC (mostly outdoor)**
- **Motors in the Air Stream**
  - **Totally Enclosed Air over or ODP air over**
  - **Often have remote mounted conduit boxes**
- **Cooling Tower/Large Condenser Fan Motor**
  - **Normally TEAO or TEFC motors**
  - **Can be direct drive or belted**

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Inverter Grade Motors

Inverter Grade® Motors

- **Developed 3 plus years ago to meet customer expectations.**
  - **With thousands of actual field installations complete, the "Inverter Grade"® Insulation system has a 100% success rate.**
- **"Total" AC Variable Frequency Design (VFD) package.**
  - **Pulse Resistant Magnet Wire (QS Wire)**
  - **Precision Phase, Slot and Cell Insulation**
  - **High Rigidity Stator Core Treatment**
    - **Double dip and bake & Extra end-turn lacing**
  - **Low Loss Electrical Steel**
  - **Thermal Protection (3 NC Class F Thermostats)**
  - **Maximized Steel and Copper Content**
  - **Low Vibration Rotor Assemblies**

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Inverter Grade® Motors

- **Feature - "Inverter Grade"® Insulation System**
  - **Reliable Performance**
  - **Reduced Downtime**
  - **Mechanical Rigidity**
  - **Improved Dielectric Withstand to meet NEMA MG1-1993, part 31**
  - **Compatibility with All Brands of PWM VFDs.**
  - **Increased Motor Life on Sinewave Power.**
- **"Inverter Grade"® Efficiency vs. a High Efficiency Motor and Output Reactor.**
  - No Extra Cabinet or Floor Space Required
  - Fewer Connections and Cable Runs
  - Increased Motor Life & Protection Against Magnet Wire Fatigue
  - No Additional System Components to Replace

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Inverter Grade® Motors

- **Feature - Low Loss Steel and Maximized Material Content**
  - Low Thermal Rise at Rated RPM
  - Wider Speed Range
  - Maximized Torque
- **Feature - Enhanced Low Vibration Rotor Assemblies**
  - Minimize Motor and Equipment Vibration
  - Helps to Minimize Motor Noise
  - Improved Thermal and Torque Capabilities
  - Improved “Overspeed” Performance
- **Feature - Thermal Protection (N.C. T-Stats)**
  - Prevents Winding Burnout
- **Feature - VFD Performance Data Plate**
  - Clearly Defined VFD Performance Levels for Future Reference.

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Inverter Duty Dripproof DI/RI

- Inverter Duty Dripproof
- For heavy inverter use. (long cable runs)
- Spec’d by User, and sometimes OEMs
- Stock to 250hp

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Inverter Duty (CTI-UTI/H&U-VFD)

- Inverter Duty is Cast Iron or Aluminum 1-200hp 140-447 Frame Stock
- For heavy inverter use. (long cable runs)
- Specified by User, and sometimes OEMs
- Can utilize new C-face and D-flange kits

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Investment Grade Motors

Selling NEMA Premium

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Efficiency Facts

- Epact regulations cover less than 75% of motors sold today. Examples: 200V ratings & 1 Phase
- Environmental groups estimate over 5 million units are repaired each year
- Repaired units loose efficiency
- The average IHP motor uses 4 to 6 times it’s original cost in electricity per year
- A NEMA premium motor can save the user money
- Gives the wholesaler opportunity to “sell up”

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Cost Comparison Direct Labor Vs Motor Efficiency

- Average cost per year for one skilled worker = $60,000
- Average cost per year to operate a 20 year old, once repaired 50HP motor $20,000
- Savings opportunity available by upgrading to Emerson NEMA Premium $800/yr or $16,000 over it’s life time
- One upgraded motor equals a 1.3% reduction in annual labor cost per person
- An average automotive plant has 800 motors and could save $640,000/year in energy costs

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Differing Views of Motor Failure

- **Customer:**
  - The system is down
  - Return to operation ASAP! No concern for any other issue, get the building cool/warm and customers/boss happy
- **Challenge:**
  - Move your customer's perspective from replacing "rotating electro-mechanical device" to one that takes advantage of a cost savings opportunity
- **The motor sales person:**
  - Replace the failed motor with a new motor (not rebuilt)
  - Sell an Emerson NEMA Premium motor
  - Justified by saving energy $ over the life of the motor

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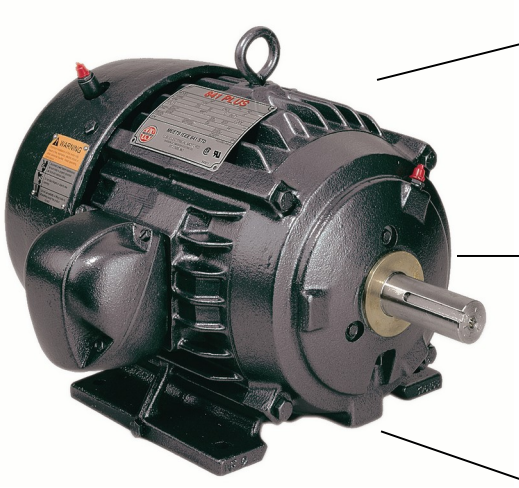
Cost Savings Opportunities Are Driven by Energy Use Reductions



Replaces motors as they fail with premium product

Analyze motors in service and replace low efficient units with Emerson Premium before they fail

Evaluate and tune complete
motor system and sizing

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Selling Premium Efficient Motors

- **Option one: Sell one unit at a time**
  - Analyze and rationalize savings for each motor/sale
  - Get dirty and sell a few motors
- **Option two: Sell the concept**
  - Demonstrate the capability to save over the range of installed motors
    - Create a motor replacement policy for your customer
    - Evaluate at a higher level
    - Reach the financial manager level
    - Cost reduction through investment grade motors
  - Stay clean sell hundreds of motors

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Your Motor Customer Has Choices

- No decision or policy " react to failure"
  - Repair vs. replace
  - Premium vs. Epact
- Horse Power based policy "react to failure"
  - 50 HP and up get repaired
  - 40 HP and less replace
    - Epact vs. NEMA Premium
- Adapt a proactive approach
  - Determine the opportunity
  - Replace motor inventory based on savings opportunity

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Summary

- Epact sets a minimum for a portion of motors your customer buys
- NEMA Premium sets a higher level endorsed by DOE, FEMP, several standards and specifier organizations
- Your sales presentation should focus on cost reduction at the financial management level avoid one on one with the plant maintenance department
- NEMA Product is a direct replacement product that fits a motor energy policy with out application issues
- Emerson can provide product and service to support a premium motor sales plan

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